National Research Council Canada

Conseil national de recherches Canada

NRC

Working with the Construction Industry

Institute for Research in Construction

Canada

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About the Cover

Canada faces huge and rapidly mounting expenditures for infrastructure renewal. Roads, expressways, bridges, streets, sidewalks, and sewer and water lines across the country are in need of repair and upgrading. The reasons are many: age, salt-induced corrosion, frost action, and increasing demands placed on them by an expanding population. The Institute for Research in Construction is assisting industry and governments to develop cost-effective repair technologies and strategies for new construction for a rejuvenated infrastructure, ready to support economic growth.

The Institute for Research in Construction (IRC) is a division of the National Research Council of Canada, and is responsible for the Council's Construction Program. With a staff of 250 engineers, scientists, architects, technical experts and administrative staff, IRC operates the Construction Program through its own research and technology development activities and through its strong affiliation with field advisors of NRC's Industrial Research Assistance Program (IRAP).

IRC's mission is to provide the construction industry with the best possible technology. This contributes to the overall mission of NRC, which is to enhance the socio-economic well-being and competitiveness of the country.

IRC's strategic objectives are:

- to undertake research of significance to the Canadian construction industry and its users;
- to develop appropriate technology and information and promote their adoption by the industry;
- to support the national construction codes, standards and evaluation systems.

Current concerns about energy costs and increasing interest in quality and durability due to environmental threats and infrastructure deterioration are important influences on IRC research programs.

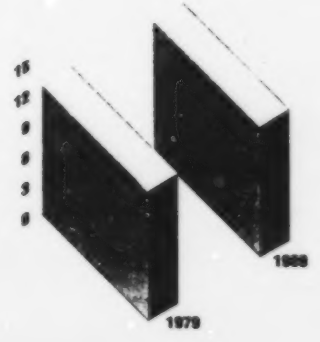
The Institute for Research in Construction served hundreds of clients and client groups in 1990, on a wide variety of research, testing, code-related and evaluation services. Among our many achievements we:

- initiated a major research project to make buildings more energy-efficient;
- conducted extensive air quality studies in two office towers;
- developed a method to make heritage buildings structurally safe;
- evaluated the strength of roofing materials under cold conditions;
- developed a way to predict the long-term performance of new plastic insulations;
- applied a fire-risk computer model to the rehabilitation of office buildings;
- assisted the provinces to move toward consistency in building regulation in Canada.

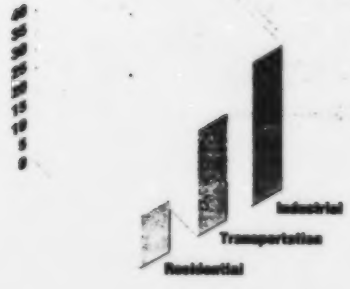
Value of New Construction (all types)
(Billions of 1989 dollars)

Value of Building Repair and Renovation
(Billions of 1989 dollars)

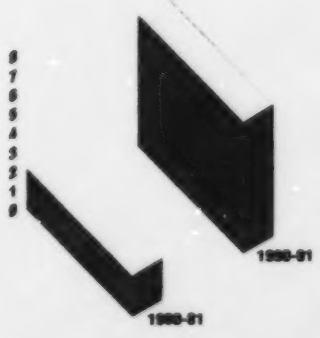
Infrastructure Costs
(Billions of 1989 dollars)



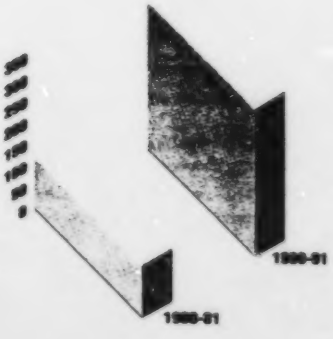
Energy Use in Canada by Sector 1989
(in percentage)



Revenue from Contracts and Tests
(in millions of 1990 constant dollars)



Publications and Client Reports
(in number)



It was an honour to be appointed chairman of the Canadian Construction Research Board in 1990. As you will see in the list of members at the end of this report, the board is composed of senior people from industry, government and universities, from across the country. These people represent many of the facets of construction, and each brings a unique perspective to the board.

Since its establishment by the National Research Council in 1985, the Canadian Construction Research Board has been an effective instrument for identifying technology needs of Canada's construction industry. We have worked closely with the Institute for Research in Construction, guiding its programs to meet those industry needs. The board has been instrumental in bringing about federal-provincial cooperation in key areas of construction, such as building codes and materials evaluation.

The board encourages the establishment of research chairs at universities. It has sponsored major conferences on construction research and technology development. It has sought informed opinion on the issues faced by the industry and facilitated the forging of strategic solutions needed to address them. Its national network of chapters is a vital link to the industry at the local level.

The National Research Council stresses its commitment to partnerships with industry groups across Canada. This report speaks of important IRC collaborations with the construction industry.

I invite you to read the report to learn how this relationship serves the construction industry and Canadians generally.

David Farlinger
Chief Executive Officer
I.D. Group, Inc.
Winnipeg

The National Research Council is celebrating its 75th anniversary in 1991. It is an opportunity for the Council to reflect on its strong past and to reinforce its principles of partnership and collaboration with Canadian industry.

With the publication of this 1990 Annual Review, the Institute for Research in Construction (IRC), a proud division of NRC, presents examples of successful collaborations with its valued clients in the construction industry, in both the public and private sector.

Construction touches the lives of all Canadians. Indeed, many of society's urgent needs have a direct relation to the construction industry: infrastructure renewal; rehabilitation of buildings; environmental protection; energy conservation; and indoor air quality. On the pages that follow, you will find examples of work accomplished in partnership with some major clients and client groups.

NRC, through IRC, conducts research on strategic issues of crucial value to industry in a highly competitive market. Through collaboration with the Industrial Research Assistance Program, chapters of the Canadian Construction Research Board, industry-led technology centres, and associations, IRC also works hard to transmit the results of research to users.

IRC is not yet 75, but rather a mature and dynamic 44. Since our beginnings in 1947 we have developed partnerships, expertise and facilities that are second to none. We are committed to excellence and we are structured to serve Canada's construction industry for many years to come.

If this review suggests some way we can help your organization, call us.

George Seaden
Director General

Saving Energy while Protecting the Environment

Concerns about energy supply and environmental threats such as global warming are forcing Canadians to consider new ways to save energy and contain demand for electricity. About 35% of all energy used in Canada is used in buildings. Despite the energy savings achieved in the seventies and eighties through new technologies, energy efficiency in buildings can be improved.

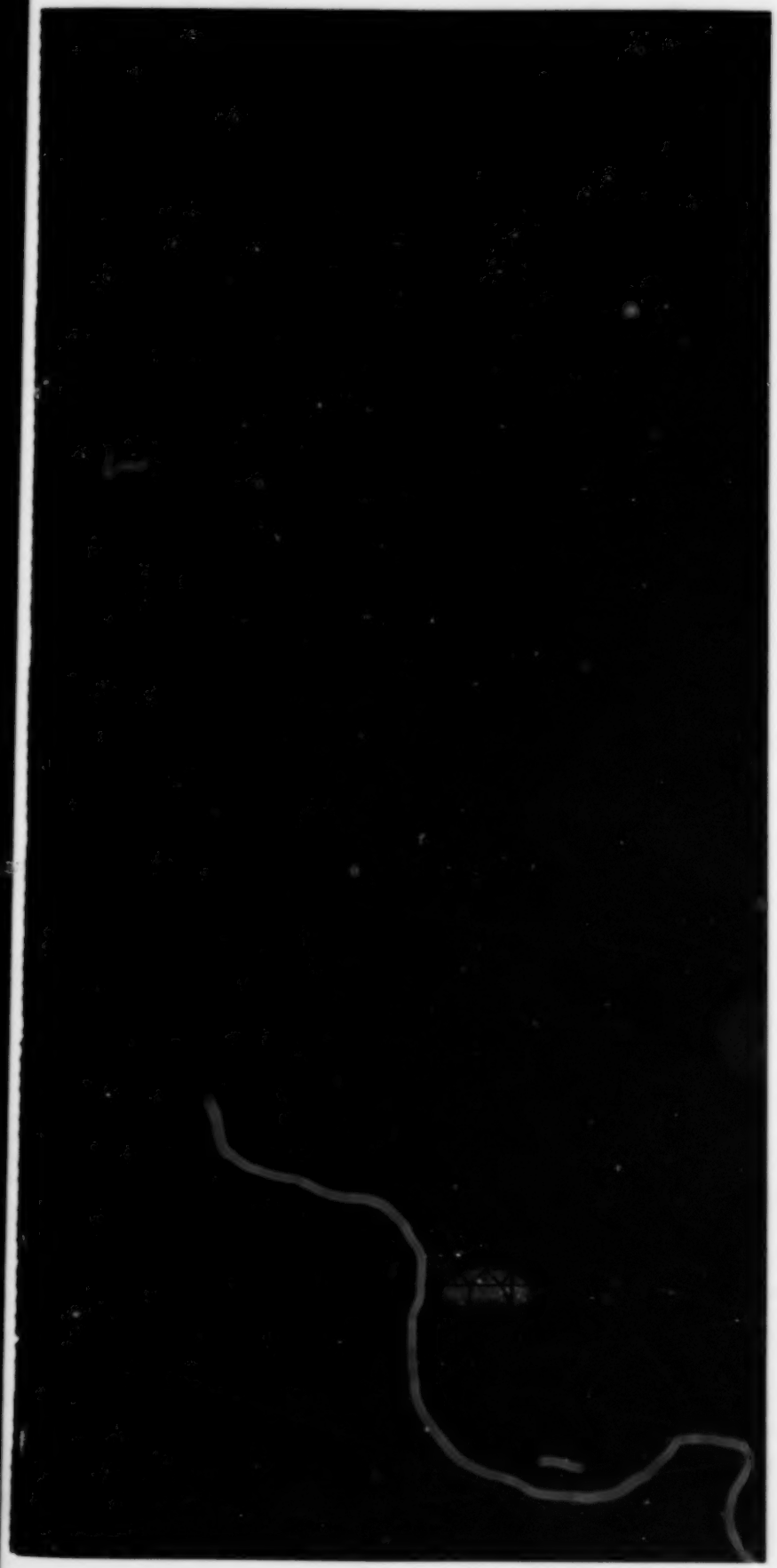
Governments and the major power utilities are eager to do their share. The proof is in a major project underway to produce a national code for energy conservation in buildings. IRC is taking the lead with a research program to study and evaluate technologies that will make gains in energy efficiency a reality.

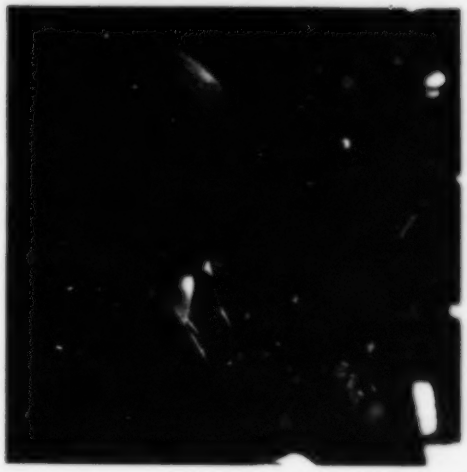
Some prominent groups are supporting the project. Among them are the Canadian Electrical Association (whose members include large utilities), Energy, Mines and Resources Canada, and provincial energy ministries. Several other large energy-related associations are showing interest as well.

IRC has the expertise and the facilities to study the many aspects of building design, construction, operation and maintenance that have potential for energy conservation. Walls, windows, heating, ventilation and air conditioning systems, and lighting are obvious examples.

Dan Sander
IRC researcher

Energy conservation and environmental protection go hand in hand. With the very significant support from CEA and others, we will make great strides in meeting both objectives.





"CEA is delighted to support this important energy initiative. The Institute for Research in Construction has a proven track record in energy research and Canadians can expect

Good Air Quality in Buildings: Comfort and Efficiency

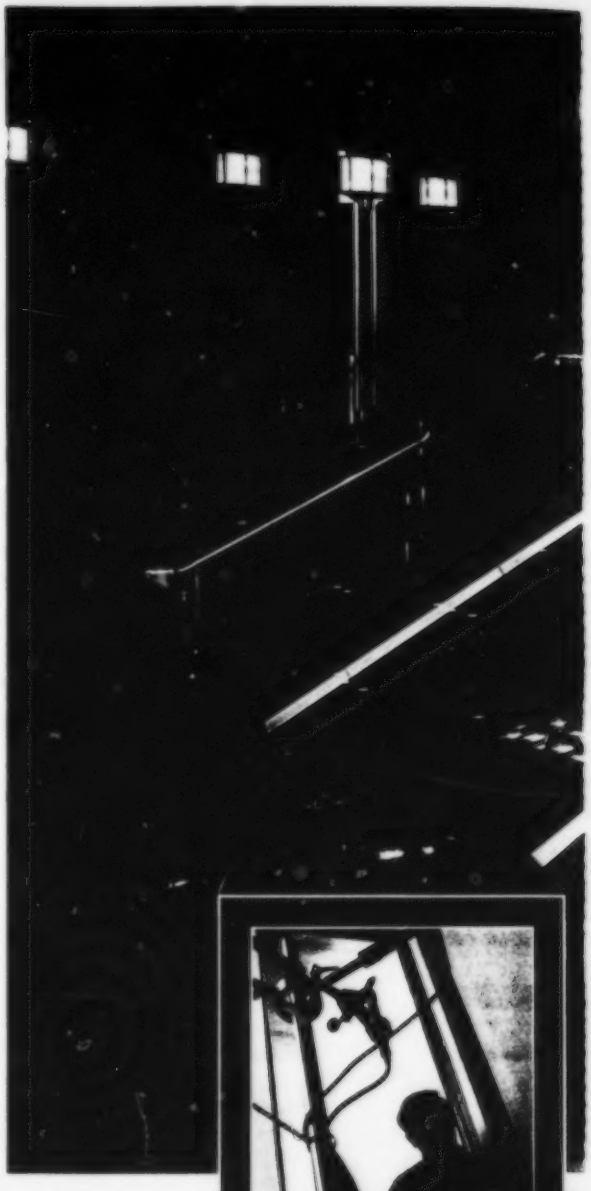
Good air quality in the workplace is crucial to employee satisfaction and productivity. Buildings must be properly designed, operated and maintained. Property managers must know how to respond to problems.

More research is needed. At the request of Canada's largest landlord, Public Works Canada, IRC is conducting extensive tests under working conditions in two office towers to assess thermal comfort and indoor air quality.

IRC is also doing laboratory studies to determine the relationship between carbon dioxide levels at an employee work station and in the return air circuit of the heating, ventilation and air conditioning system.

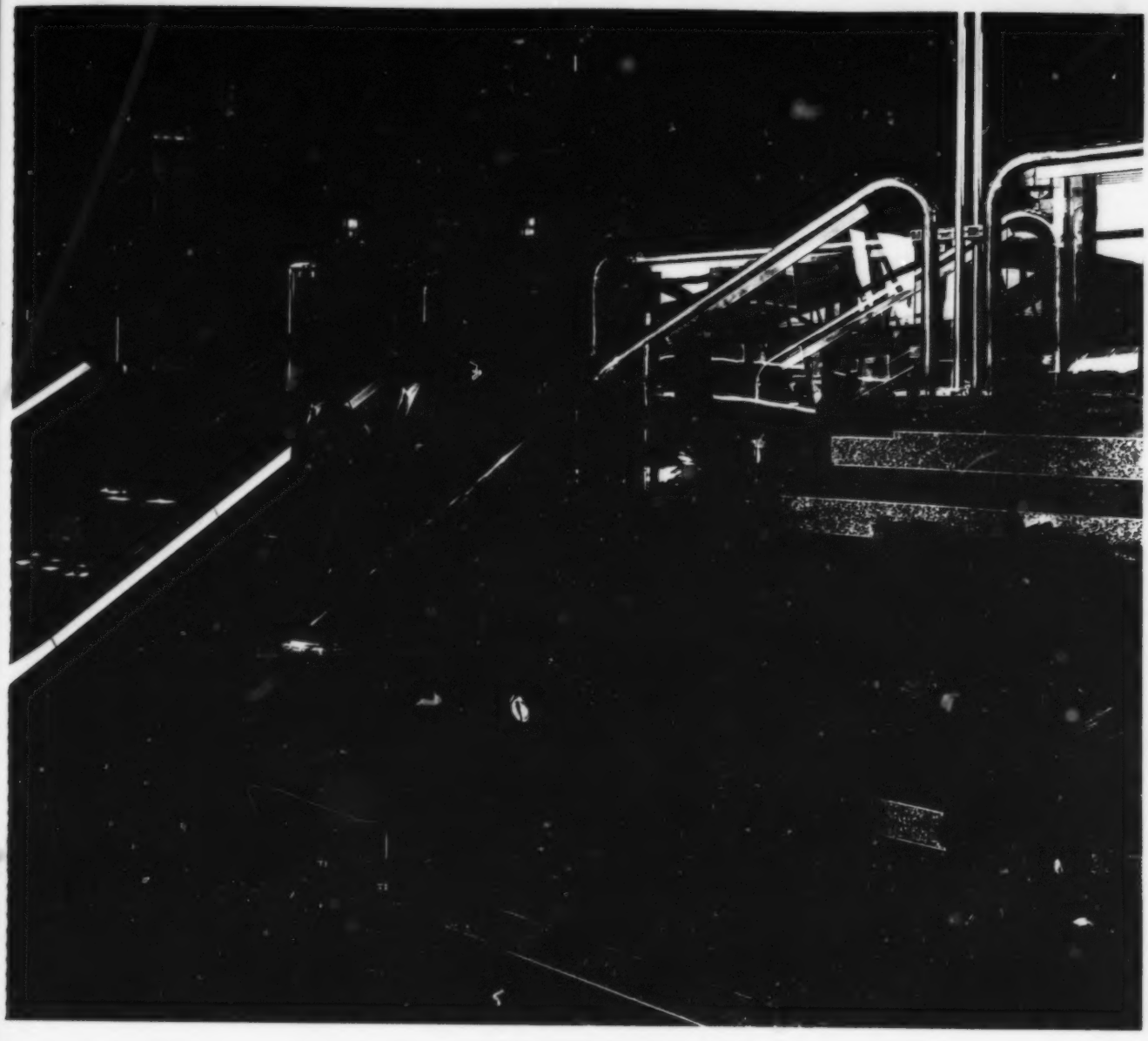
IRC and Public Works Canada have jointly produced an indoor air quality handbook to assist property managers to diagnose and prevent ventilation problems. They are now producing a second handbook for HVAC engineers and technologists.

The knowledge gained will, of course, be made available to designers, suppliers, owners and other users in the private sector. Once this knowledge is put into action, satisfaction and, hence, productivity of building occupants, should increase.



Dr. John Shaw
IRC researcher

"There are many factors to consider in identifying and resolving indoor air quality problems. The opportunity to carry out tests in real office settings is invaluable."



"IRC is a leader in indoor air quality research in Canada. Dr. John Shaw's work will give our building managers and engineers a better understanding of air quality problems and how to solve them."

David Patton

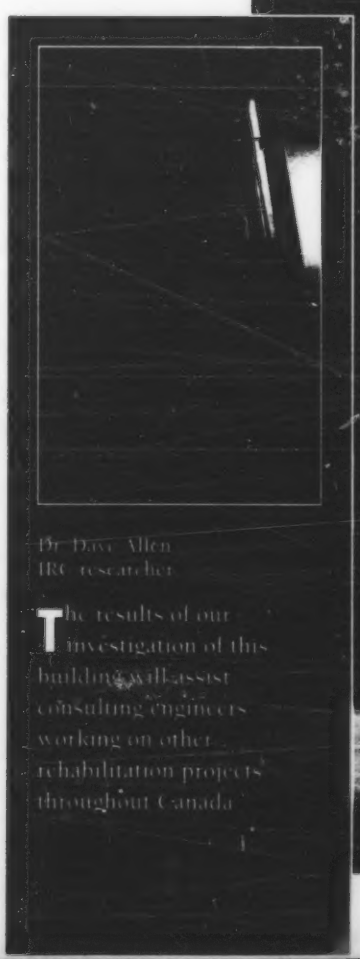
Director, Property Management Best Practices, Public Works Canada

Old Buildings, New Uses: Structural Considerations

The rehabilitation of buildings now exceeds the value of new construction. Much of the cost lies in the upgrading needed to meet the structural and fire safety requirements of today's building codes. Current structural design codes, however, are not always practical for rehabilitation. Yet, consultants need reliable alternatives to alleviate construction difficulties while ensuring structural safety. IRC is carrying out research to develop alternatives and accompanying guidelines to enable consultants to apply the intent of building codes to rehabilitation.

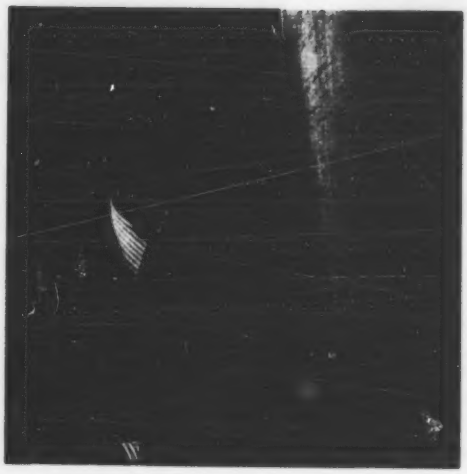
With heritage buildings, the challenge is to rehabilitate without destroying their heritage value. In one such case, IRC joined forces with the National Capital Commission and the consulting engineering firm of Adjeleian Allen Rubeli to evaluate the Central Chambers building in Ottawa's Confederation Square. Designated a Class A-1 heritage building, it is to be part of a new development planned by Perez Bramalea.

The building, made of un-reinforced, load-bearing masonry walls, requires major renovations to make it earthquake resistant. IRC structural engineers tested the shear resistance of the walls and are helping the consultant meet the intent of the earthquake requirements of the building code by applying an alternative evaluation and rehabilitation methodology developed in California.



Dr. Dave Allen
IRC researcher

"The results of our investigation of this building will assist consulting engineers working on other rehabilitation projects throughout Canada."



"IRC has always been a valuable resource for the Canadian construction community. Dr. Dave Allen helped us greatly to address the challenges presented by the Chambers building."

Vesselin Tzolov

Senior Vice President, American Alloy Rubedi

Making Roofs Last Longer in our Cold Climate

Roofs take a constant beating in Canada's cold climate. With winter design temperatures ranging from -30 degrees Celsius to -50 degrees, premature failure is common. But there is little information available to explain why some roofing materials fail and others don't. Designers have only their experience to draw on when assessing the suitability of materials for each project.

This is all changing with a research project equally funded by Canada Post Corporation, the Department of National Defence, Public Works Canada, and IRC. The project is a study of the change in physical properties of roofing membranes subjected to progressively colder temperatures under controlled laboratory conditions.

IRC roofing experts are conducting over 5000 tests on materials provided by 12 companies. The research covers all four major generic groups of roofing membranes in use today. The strength of samples exposed to accelerated aging in the laboratory is being compared to the strength of field samples taken from actual roofs that have been in service for various periods of time.

The results should explain how roofing materials behave under cold conditions and take the guesswork out of selecting membranes for specific uses. This, coupled with good design and construction practices, will result in more-durable roofs and a lower failure rate.

Dr. Ou Dai
IRC researcher

The support of our three collaborators allows us to do an extensive study of roofing materials under cold conditions. Property owners, developers, designers and contractors will all benefit from the work.

"All three supporters of this project have a large capital investment in buildings. By pooling our resources with IRC's research capability, we stand to save money in the long run by reducing roof maintenance and replacement costs."

Hans Steinman
Manager, Architectural and Design Services,
Canada Post Corporation

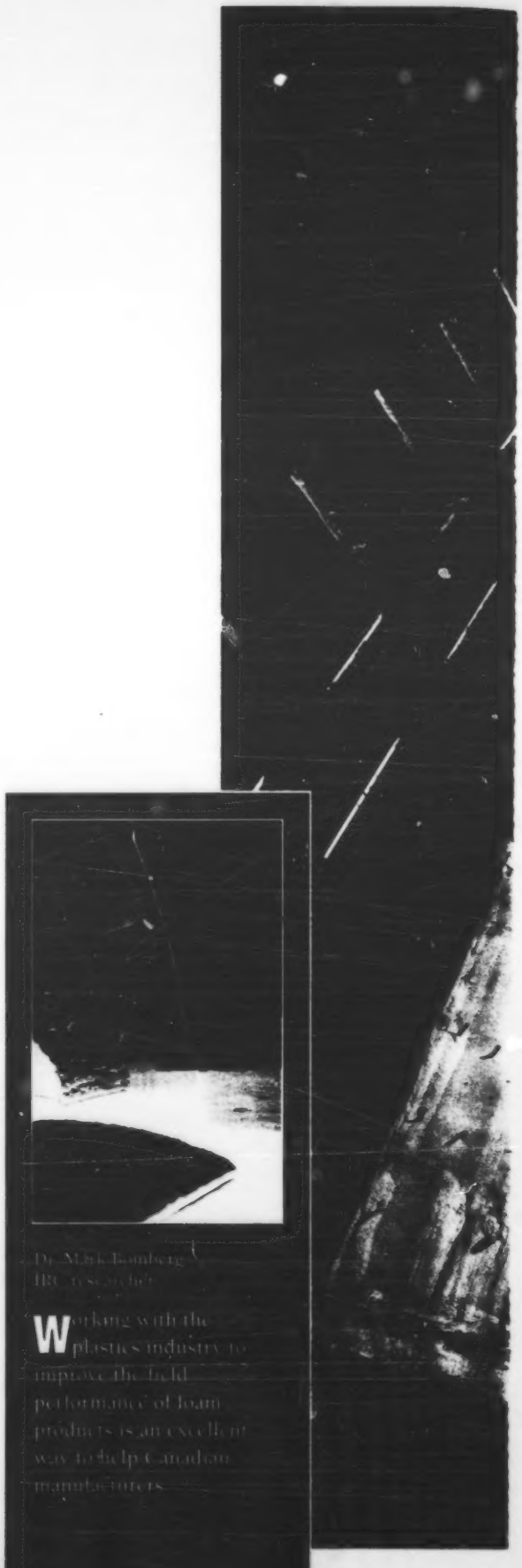
Plastic Insulations: Fast-tracking Research and Development

A very successful research partnership between IRC, the Society of the Plastics Industry (SPI) and Du Pont Canada is helping Canadian manufacturers develop new cellular plastic insulations.

The impetus was environmental concerns stemming from the Montreal protocol of 1987, when nations agreed that the use of ozone-depleting chlorofluorocarbons (CFCs) should be stopped. Since CFCs are the blowing agents in a number of plastic insulations, Canadian manufacturers were faced with two problems. They had to develop new blowing agents, and they had to evaluate insulations made with these agents. But they did not have the luxury of taking years to evaulate their products; the market would not wait for them.

The answer was IRC/SPI/Du Pont collaboration. About thirty companies, including BASF, ICI and Domtar, have joined forces to support the research. The focus is on spray foam, several types of board stock, and expanded polystyrene insulations.

IRC's key contribution was to develop a method to predict long-term performance. Researchers then used the method to evaluate generic insulation types that could be produced without CFCs. Work continues to identify promising board stocks made with CFC alternatives.



Dr. Mark Bomberg
IRC research

Working with the plastics industry to improve the field performance of foam products is an excellent way to help Canadian manufacturers.

"My company feels that this project is an excellent example of public and private sector cooperation in research and development. IRC's expertise and facilities have been invaluable in helping industry tackle a major economic and environmental challenge."

William Barley
General Manager, Fluorochemicals, Du Pont Canada

International Cooperation to Evaluate Fire Risks and Costs

Good fire protection costs money. The difficulty is to determine the fire risks and to design in a cost-effective way to deal with those risks. This is true not only for new buildings but also increasingly for renovation projects.

IRC is using its international connections to help Canadian engineers deal with the problem. Experts at the Footscray Institute of Technology in Australia had developed a computer model for evaluating fire risks and fire costs in office buildings. IRC fire researchers are now working with the Australians to apply the model to Canadian buildings.

One such application is office building retrofits. Public Works Canada which, like other landlords, often retrofits office space or converts industrial buildings to office use, needed a reliable way to assess whether retrofits would meet the intent of fire safety provisions of building codes. IRC is using the computer model to help the department to evaluate cost-effective fire-safety alternatives. The model, which will operate on a personal computer, will eventually be available for commercial use by building owners, designers and code authorities.

Postscript: Like a boomerang, IRC's work has generated interest in Australia in using the model for evaluating the fire safety of wood-frame apartment buildings.

Dr. David Yung
IRC research officer

The model is a tool that will be useful to both the designer and the building official as they assess whether fire safety aspects of a building are being addressed satisfactorily in a cost-effective manner.

"My client needed a better way to assess the fire safety of wood construction. IRC's experience applying the risk-cost model to office buildings is of great interest to us."

Ron Thomson

Consultant to the National Association of Home Builders, Australia

Building Regulation: the Provinces Work Together

Construction is a huge engine of economic growth in Canada, annually generating $100 billion in business and accounting for 15% of the GNP. An advanced building code system is needed to lubricate this engine.

Building regulation is a provincial jurisdiction. But many companies in Canada operate nationally. Developers, contractors, designers and manufacturers stand to save time and money if building code requirements are consistent across the country. This consistency now appears ever closer, thanks to the creation of the Provincial/Territorial Committee on Building Standards, which works closely with the provincial governments and IRC.

There have been two key actions. First, the provinces have agreed to use the National Building Code, with as few changes as possible, as the instrument for regulation across Canada. This will introduce greater efficiencies into the construction process.

Second, the provinces have resolved to recognize the materials evaluation service offered by IRC's Canadian Construction Materials Centre. A single evaluation service eliminates duplicate services offered by the provinces, gets new products to the marketplace quickly, and enhances interprovincial trade.

John Berndt
Manager, Canadian Construction Materials Centre, IRC

IRC has had a long history of supporting the development of the National Building Code. We are pleased to see the provinces adopt both the code and our evaluation service.

"The committee believes that its work will trigger significant savings for the construction industry and governments across Canada. We rely heavily on IRC because of its leadership and technical competence in both building codes and materials evaluation."

John Reimer
Director, Engineering Safety Branch, Manitoba Labour, and Chairman, Provincial/Territorial Committee on Building Standards

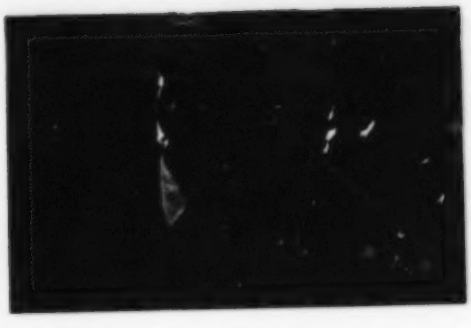
You have just read about some key IRC activities and you have seen some of the IRC people involved. Below, we feature six other people who play important roles in serving you.

Joan Allen

Joan is manager of IRC's publications sales and distribution system, including our client database. She also manages the distribution of a selection of European publications.

Doreen Taylor

Doreen is office manager in the Canadian Construction Materials Centre. She answers many a query from manufacturers who visit or telephone the Centre seeking information on product evaluations.

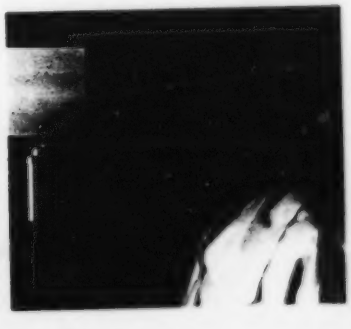


Jim Nolen

Jim is IRC's marketing manager. He is on the road a lot, listening carefully to industry leaders tell of their needs, and informing them about IRC services and facilities. His able staff ensure that all requests for services are handled promptly and accurately.

Pierre Gratton

Pierre is an industry technology advisor linked directly to industry through NRC's Industrial Research Assistance Program. Pierre has many years of experience in bridge construction and is active in rehabilitation projects.



Anna Delgado

Anna is a technical officer who is part of the IRC research team in roofing materials, sealants and adhesives. She has taken part in a number of contracts for major clients.

Graeme Consiglio

Graeme, an architect, works closely with the construction industry, with emphasis on architects and consulting engineers. He is a member of the Board of Directors, Royal Architectural Institute of Canada.

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